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THE FIELD STATUS OF PARASITES OF THE EUROPEAN CORN BORER

IN THE FALL OF 1937

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Surveys were conducted after the active season of 1937 both in the Lake States and in the Eastern States in order to determine the current status of parasites of the European corn borer, with special emphasis on species that have been imported and released at various localities in the infested area. The field collecting of material for subsequent laboratory handling was restricted to localities in the vicinity of points previously selected for testing the reaction of parasites to environments in the United States. Each of the surveyed localities was sampled by the section-random sampling method, the location of samples being determined by the use of polar coordinate or transect designs of a type suitable to the objectives sought at each point.

In the Lake States area collections were made at 5 colony sites, and a special survey was made along the western shore of Lake Erie, including part of the Maumee River Valley, to determine the dispersion of the tachinid parasite Lydella stabulans grisescens R. D. from the Jerusalem Township, Lucas County, colonization point in Ohio and the Monroe and Erie Township, Monroe County, points in Michigan. One hundred eighty-one samples, averaging 81.6 borers each, or a total of 15,666 larvae, were collected at the various survey points.

In the Eastern States surveys were made at the following points: Malden, in Middlesex County, and Taunton, in Bristol County, Mass.; East Hartford, in Hartford County, Conn.; Atlantic Township, in Monmouth County, N. J.; and Lee District, in Accomac County, Va.

Three hundred eighty-six samples, averaging 97.8 borers each, or a total of 37,736 larvae, were collected at the various survey points in both areas. The results of observations in the two areas are summarized in tables 1 and 2.

Table 1.--Summary of parasites recovered in the Lake States area in the fall of 1937

| State and County | Township | Parasites recovered | | | | | | | | | |
|------------------------|-----------|---------------------|------------------------|-------------|-------------|-------|----------|--------------|-------|----------|----------|
| | | Borers: ob- | Collectors: Lydella | griseescens | punctatoria | Total | Natives* | Undetermined | Total | Imported | Native |
| No. | No. | No. | No. | No. | No. | No. | No. | No. | No. | No. | No. |
| Michigan: | | | | | | | | | | | |
| Monroe--: | Erie | 688 | 7 | 104 | 15.1 | 1 | 0.2 | 105 | 15.3 | 0 | 1.3 |
| Augusta--: | Washteraw | 670 | 7 | 0 | -- | 0 | -- | 0 | -- | 1:0.2 | 0 |
| Ohio: | | | | | | | | | | | |
| Erie--: | Perkins | 647 | 7 | 54 | 8.4 | 0 | -- | 54 | 8.4 | 0:-- | 1 |
| Hancock-: | Marion | 664 | 7 | 0 | -- | 0 | -- | 0 | -- | 0:-- | 0 |
| Lucas--: | Jerusalem | 4,679 | 51 | 450 | 9.6 | 0 | -- | 450 | 9.6 | 3:0.1 | 22 |
| Special survey: | | | | | | | | | | | |
| Lucas--: | Toledo | 8,318 | 102 | 169 | 2.0 | 0 | -- | 169 | 2.0 | 33:0.4 | 17 |
| Total | | 15,666 | 181 | 777 | 5.0 | 1 | 0.0 | 778 | 5.0 | 37:0.2 | 49 |
| | | | | | | | | | | | 0.3 |
| | | | | | | | | | | | 864: 5.5 |

* Includes Panzeria penitalis Coq., Zenillia caesar Ald., Labrorychus prismaticus Nort., and Bassus agilis Cress.

Table 2.—Summary of Parasites recovered in the Eastern States area in the fall of 1937

* / No release of this parasite at point indicated.

Status of Parasites as Determined by the 1937 Surveys

Lydella stabulans grisescens R. D.--This tachinid parasite was of primary importance in the Lake States area at all points adjacent to Lake Erie. In Jerusalem Township, Lucas County, Ohio, where the parasite has been present for 8 years, the 1937 survey showed that the area from which it was recoverable had extended considerably to the south and east. Samples from five of the fields examined at this point showed parasitization percentages of 69.2, 61.0, 50.5, 48.4, and 41.7, respectively.

Table 3.--Annual fall parasitization by Lydella grisescens about the Jerusalem Township, Lucas County, Ohio, release point

| Year | Parasitization within radius of release | |
|------------|---|---------------------|
| | $\frac{3}{2}$ miles | $\frac{7}{2}$ miles |
| | Percent | Percent |
| 1932-----: | 0.3 | --- |
| 1933-----: | 2.8 | --- |
| 1934-----: | 6.3 | --- |
| 1935-----: | 7.6 | 4.4 |
| 1936-----: | 10.0 | 7.0 |
| 1937-----: | 22.5 | 9.6 |

The progressive increase in parasitization, as shown by table 3, indicates that Lydella grisescens did not reach equilibrium previous to 1937, even within the $\frac{3}{2}$ mile radius of the release point. The parasitization within the continuously parasitized area at the Jerusalem colony site amounted to 20 percent. This is the highest parasitization recorded at any point in either area and indicates an environment particularly favorable to the development of the species.

In Erie Township, Monroe County, Mich., and in Perkins Township, Erie County, Ohio, two of the oldest colony sites in the Lake States area, the parasitization by Lydella grisescens showed a remarkable increase in 1937 over that of 1936, the percentage of increase at the two points being 68.6 and 918.3, respectively. Observations designed to determine the distribution of this tachinid in the Maumee River Valley and northward into Michigan along the western shore of Lake Erie over an area 20 miles long and 9 miles wide, showed L. grisescens to be present and in greater abundance in all the quadrates in the vicinity of marshland bordering the lake or streams within the area observed. With one exception Lydella was not found at a greater distance than 4 miles from the lake shore (see map 1).

This imported tachinid was recovered from all five of the regions in which host collections were made in the East. It occurred in maximum abundance in a restricted area extending northeasterly in the vicinity of Taunton, Mass. Parasitizations of about 15 percent occurred in samples taken between Taunton and Fall River, Mass. L. grisescens was known to be present at the close of 1937 in a territory totaling over 837 square miles in the Eastern States area.

Inareolata punctoria Roman.--A single specimen of this ichneumonid parasite was recovered near the Erie Township, Monroe County, Mich., colony site, at a point where it has been taken for 5 consecutive years. In the East, however, this parasite was generally dispersed in the vicinity of Boston, in southeastern Massachusetts, and around the colony site near Hartford, Conn. It was found to be present over an area of 524 square miles in the Boston area, with several collections from this area showing parasitization of over 10 percent and one of 17.3 percent. I. punctoria was present throughout the area within 12 miles of Taunton, Mass., covering an area of 226 square miles, with parasitization as high as 10 percent (see map 2).

In the East Hartford, Conn., area this parasite has increased very rapidly in abundance and in the extent of its distribution since 1936. Released at this point in 1934, at the close of 1937 it covered about 15 square miles and was recovered from 19 of the 26 collections made. One collection yielded 23 parasites, or 24.5-percent parasitization. This larval parasite was recovered from one section at Atlantic, N. J., but was not recovered from the Lee, Va., district. At the close of 1937 I. punctoria was present in an area totaling not less than 756 square miles in the infested area in the Eastern States.

Macrocentrus gifuensis Ashm.--This species was not recovered from the Malden, Mass., area but its firm establishment and continued maintenance were again confirmed for the Taunton, Mass., area. In the latter area M. gifuensis was reared from 15 separate collections obtained in a district extending over 45 miles from the vicinity of Tiverton, on Mount Hope Bay in Rhode Island, northeast as far as collections were made in the direction of Scituate, Mass. (see map 2). Since a number of scattered liberations of Macrocentrus were made in this area, its present distribution does not necessarily represent dispersion from any one point. However, it is probable, as judged by the relative abundance of the parasite in parts of the area from which it was recovered, that most, if not all, of its present distribution may be traced to the original release of 41 adults of the Oriental strain made at Bridgewater, Mass., in 1931, or to the release of 8,686 adults of the same strain at the same locality in 1932. The 1932 release was the last liberation of the species in this locality. It was not until 1936 that a parasitization as high as 20 percent was recorded. In the 1937 fall collections, the highest parasitization was 33 percent. M. gifuensis had not yet been released at the other points surveyed in 1937.

Chelonus annulipes Wesm.--The braconid parasite C. annulipes, which attacks corn borer eggs, was recorded in numbers from the Taunton, Mass., area only but here it was obtained from 12 separate collections. The parasite is concentrated within an area of approximately 75 square miles centering at Berkley (see map 2), but was also recorded at 2 other points in the Taunton area, one near the town of South Wareham about 10 miles southeast and one near Abington, almost 15 miles north of the area of high concentration. In 3 collections made in the central part of the Taunton area parasitization by this species was 13.0, 15.2, and 24.0 percent. The only other point where C. annulipes was recovered in the 1937 survey was in the Lee district of Virginia, where 2 specimens were taken in the immediate vicinity of the locations where this parasite was released in 1936 and 1937.

Cremastus flavoorbitalis (Cameron).--This species was again recovered from one section of the Taunton area, showing its continued maintenance there, but it has failed to increase to sufficient numbers to be recovered outside of a very restricted district. However, the collection from which this parasite was reared was made about 4 miles from the site where it was taken in 1936.

Phaeogenes nigridens Wesm.--A survey conducted during the summer of 1938 to determine the status of P. nigridens in eastern Massachusetts showed this imported pupal parasite to be present over an area of about 10 square miles. Collections in which the parasite appeared were made in two districts, one lying in the vicinity of Waltham, Arlington, and Lexington and the other near West Peabody and Danvers. One collection showed a parasitization of over 10 percent.

Native parasites.--Four species of native parasites, Panzeria penitalis Coq., Zenillia caesar Ald., Labrorychus prismaticus Nort., and Bassus agilis Cress., were recovered in the 1937 surveys. In no instance did the parasitization by any of these parasites average over 1 percent.

Parasite Status at Two Release Points in the Eastern Area

The Malden, Mass., area.--The parasite complex at Malden, the center of several of the oldest release points in the United States, is made up chiefly of two parasite species, Inareolata punctoria and Lydella griseascens, both introduced into the United States from Europe and the Orient. Table 4 gives a comparison of the percentages of corn borer parasitization by exotic species for comparable districts of the Malden area for the period 1927-37, inclusive.

Table 4.--Corn-borer parasitization in a comparable portion of the Malden, Mass. area, 1927-37, inclusive

| Year | Parasitization | Year | Parasitization |
|------------|----------------|------------|----------------|
| | Percent | | Percent |
| 1927-----: | 2.79 | 1933-----: | no data |
| 1928-----: | 5.17 | 1934-----: | 14.53 |
| 1929-----: | 6.87 | 1935-----: | 16.11 |
| 1930-----: | 9.67 | 1936-----: | 14.05 |
| 1931-----: | 9.87 | 1937-----: | 9.66 |
| 1932-----: | 15.16 | ": | : |

It may be noted from table 4 that there was a steady increase in parasitization of the borer from 1927 to 1932 and that for the period 1932 to 1936, inclusive, this remained more or less static at approximately 15 percent. At the close of 1937 parasitization was considerably below that for the previous 5 years and was no higher than in 1930. Data at hand indicate that the reduction in the population of parasites, as compared to host abundance, took place between the time of the 1936 survey in November of that year and a 1937 summer survey late in July and early in August. The

parasitization has always been much higher, usually at least twice as high, on the first or summer generation than on the overwintering generation. In 1937 this was not the case, the parasitization of the overwintering borers, as determined in the fall survey, being higher than in the previous summer, indicating that the parasites have already started a return toward the normal equilibrium position, believed to be approximately 15 percent for the parasite complex on the overwintering borers in this region.

It should be emphasized that the above discussion concerns only the central 154 square miles of the Malden district comparable to the area surveyed in previous years. The dispersal of the parasites has continued with the result that the region surveyed in 1936 was increased to cover a circular area 26 miles in diameter, or 531 square miles, and increased again in 1937 to cover a region 36 miles in diameter, or a territory of 1,018 square miles. The total parasitization in the 531 square miles surveyed in 1936 was found to be 14.90 percent, but in the fall of 1937 the parasitization in this same territory was only 7.95 percent, showing that the same decrease that had taken place in the central district had also occurred in this larger district. The parasitization of the corn borer in the whole Malden area of 1,018 square miles at the close of 1937 was found to average 5.44 percent.

The Taunton, Mass., area.--Prior to 1937 a number of small surveys for parasites had been conducted in southeastern Massachusetts and eastern Rhode Island. In 1934 Lydella grisescens was the only parasite recovered from survey collections made at East Providence, R. I., and Bridgewater, Mass.; however, one mass of cocoons of Macrocentrus gifuensis was found in that year in the course of other work near Bridgewater.

In the fall of 1935 a district 5 miles in diameter, or approximately $19\frac{1}{2}$ square miles in area, was surveyed at East Providence. Lydella grisescens was again recovered, as in 1934, but Inareolata punctoria was also found to be present in measurable numbers. At the Bridgewater point, collections over a district 3 miles in diameter, or about $7\frac{1}{2}$ square miles, failed to show the presence of M. gifuensis or I. punctoria, but L. grisescens was again recovered. As numerous releases of several species of parasites had been made over a period of years up to 1932 in a district extending from Taunton to Swansea, Mass., a survey of a strip 2 miles wide and 14 miles long was made in this district in 1935. In addition to revealing the presence of L. grisescens and I. punctoria, the survey also showed that Chelonus annulipes was present in considerable numbers at Dighton and Taunton.

In 1936 a survey of 78.5 square miles around Dighton showed that Chelonus annulipes was present over this territory and, from its recovery at the outer edge of this district, probably beyond the limits of the survey. Lydella grisescens and Inareolata punctoria were also found throughout this district, and Macrocentrus gifuensis was recovered in numbers from some sections. A survey at Bridgewater of a larger area than in 1935 ($19\frac{1}{2}$ square miles in 1936 as compared to $7\frac{1}{2}$ square miles in 1935) confirmed the presence of M. gifuensis, first found in 1934.

As the 1936 surveys showed Macrocentrus gifuensis at both Dighton and Bridgewater with indications that it was probably present in the territory between these points, as Chelonus annulipes was believed to be present beyond the area surveyed in 1936, and as the indications were that Lydella grisescens and Inareolata punctoria were dispersed over a considerable area, a survey of a territory 45 miles in diameter, covering an area of 1,595 square miles, extending from just south of Boston, Mass., to and including Providence, R. I., was surveyed in the fall of 1937. This territory covered almost all of southeastern Massachusetts, except Cape Cod east of the canal, as well as a part of Rhode Island, and included the districts previously surveyed separately at Bridgewater, Dighton, Taunton, and Swansea, Mass., and East Providence, R. I.

The Taunton region, as outlined above, was surveyed in 1937 by utilizing a polar coordinate design centering at Taunton, Mass. The percentage of parasitization of the borer by the exotic parasite complex, consisting of Inareolata punctoria, Lydella grisescens, Macrocentrus gifuensis, and Chelonus annulipes, decreased as the distance from the center of the survey increased. Not only was this true of the introduced parasite complex as a whole, but it was also the case with each of the four principal parasites making up that complex. Cremastus flavoorbitalis, although an introduced parasite present in this area, is still too scarce to be of importance in the parasite complex of this area. Sufficient time has not elapsed since the establishment of the parasite colonies at the remaining points surveyed in 1937 in the eastern area to allow comparative yearly studies of the parasite complex.

Summary

Surveys conducted at the close of the 1937 season showed that in the Lake States area the parasite of first importance was Lydella stabulans grisescens. It was abundant near the marshland at the southwestern shore of Lake Erie, and in this region parasitization of over 60 percent in some samples of borers was noted.

In the eastern area the most important parasite complex centered at Taunton, Mass., in which region five species of imported parasites predominated. These were Lydella stabulans grisescens, Macrocentrus gifuensis, Chelonus annulipes, Inareolata punctoria, and Cremastus flavoorbitalis, listed in order of their effectiveness, L. grisescens assuming first place because of its more general distribution.

The highest parasitization in individual fields was by C. annulipes. In the vicinity of the oldest release points in the United States, centering at Malden, Mass., Inareolata punctoria was of first importance. The pupal parasite Phaeogenes nigridens was recovered at several points in the Malden area.

Exceptionally high parasitization by Inareolata punctoria was noted at the comparatively recently established liberation point near E. Hartford, Conn.

Chelonus annulipes was recovered in the Lee district in Virginia, but at this point, as well as in the Atlantic, N. J., district, parasitization was low.

MAP I
DISTRIBUTION OF LYDELLA STABULANS
VARIETY GRISESCENS R.D.
SOUTHWESTERN SHORE OF LAKE ERIE

• FIELDS IN WHICH LYDELLA
WAS RECOVERED

LAKERIE

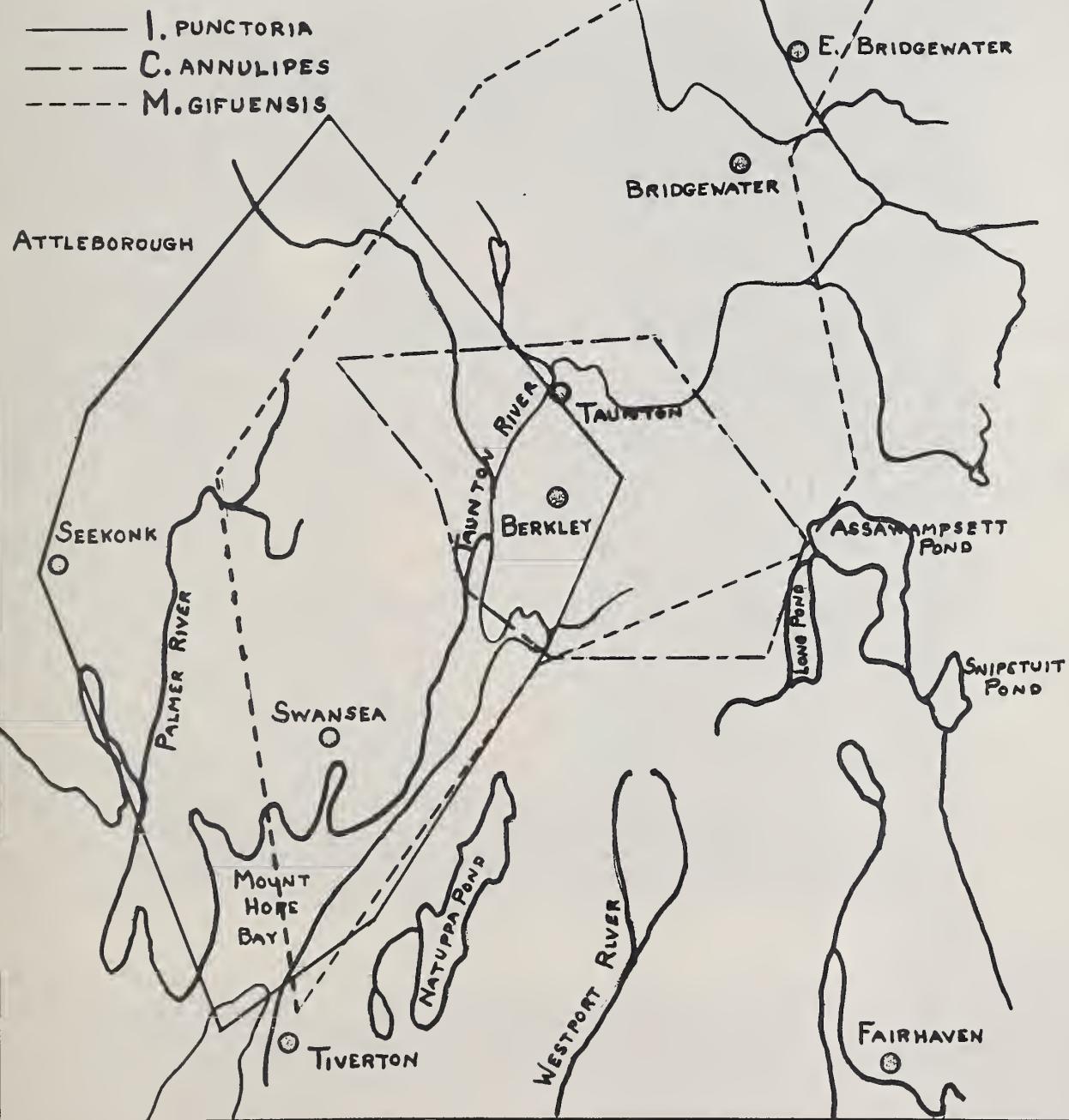
z ← +

SCALE $\frac{1}{125000}$

MAP 2

TAUNTON MASSACHUSETTS SURVEY-FALL 1937

0 2 4 6
SCALE OF MILES



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